9. WORKSHOP 1: What is a 'Capability System Model'?

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Abstract

In the current Defence acquisition system, the Capability System is described principally in the text-based Capability Definition Documents (CDD) set of documents, which are provided to potential prime contractors through a formal tendering process. Tenderers are required to digest the CDD in order to propose system-level solutions to the Materiel System. Tendered solutions are assessed by the customer for compliance with the CDD (as well as with other terms and conditions of the tender). This text-based process is often perceived as inefficient, with a high likelihood of errors. One way to overcome these shortcomings would be to use an MBSE approach to pass Capability System models across the contractual interface and integrate them to the Materiel System models included in the tendered solutions.

In an MBSE-supported system acquisition, however, the Materiel System is treated as a black box with its internal functions being subsequently defined by the tenderers in the solution space (presumably in a different way by each of the tenderers). To that end, the Capability System Models developed by the customer would treat the Materiel System as a single entity in order to show how it would be operated and supported in the operational environment. These Capability System Models would then be passed across the acquisition boundary so that tenderers can show how their tendered Materiel System model performs in the context of the Capability System Model.

In order to be in position to use a Capability System Model as part of the acquisition of a Materiel System, the customer must therefore undertake considerable modelling of the wider context of the Capability System as well as of the relevant Fundamental Inputs to Capability (FIC)[4] elements.

This workshop examines how a Capability Systems Model could be used to replace the existing text-based content of the CDD documents. In particular:

- The workshop will begin with an examination of the existing CDD in order to identify which elements of the existing documents can be replaced by the Capability System Model and which elements would need to remain text-based. Relevant documents include the Operational Concept Document (OCD) and the Function and Performance Specification (FPS).
- Attention will then turn to identifying the degree to which the customer's business processes be modelled in order to provide an appropriate level of abstraction for the Capability System Model, so that it is suitable to be used as the major artefact to cross the acquisition boundary.

[4] The FIC is the standard list for consideration of what is required to generate Defence capability, comprising *organisation*, *personnel*, *collective training*, *major systems*, *supplies*, *facilities*, *support*, and *command & management*.

Report Documentation Page

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14. ABSTRACT
In the current Defence acquisition system, the Capability System is described principally in the text-based Capability Definition Documents (CDD) set of documents, which are provided to potential prime contractors through a formal tendering process. Tenderers are required to digest the CDD in order to propose system-level solutions to the Materiel System. Tendered solutions are assessed by the customer for compliance with the CDD (as well as with other terms and conditions of the tender). This text-based process is often perceived as inefficient, with a high likelihood of errors. One way to overcome these shortcomings would be to use an MBSE approach to pass Capability System models across the contractual interface and integrate them to the Materiel System models included in the tendered solutions. In an MBSE-supported system acquisition, however, the Materiel System is treated as a black box with its internal functions being subsequently defined by the tenderers in the solution space (presumably in a different way by each of the tenderers). To that end, the Capability System Models developed by the customer would treat the Materiel System as a single entity in order to show how it would be operated and supported in the operational environment. These Capability System Models would then be passed across the acquisition boundary so that tenderers can show how their tendered Materiel System model performs in the context of the Capability System Model.

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Specifically, the workshop will address the following three questions:

Question 1: What information and processes currently described in text-based systems acquisition (TBSA) (i.e. in the OCD and FPS) would still be required to be included in some way in the MODEL which is the basis of model-based systems acquisition (MBSA)?

Question 2: How can each information/process be modelled in MBSA, and how would that be different to TBSA?

Question 3: What processes/information would be modelled in MBSA that do not exist in TBSA?

Facilitator Biography

Dr Michael John (Mike) Ryan is a Senior Lecturer with the School of Engineering and Information Technology, University of New South Wales, at Canberra. He holds Bachelor, Masters and Doctor of Philosophy degrees in electrical engineering as well as a Graduate Diploma in Management Studies. In addition, he has completed two years formal project management training in the United Kingdom. For the first seventeen years of his career he held a number of communications engineering, systems engineering, project management, and management positions in the Australian Army. Since joining UNSW, he has become an internationally recognised expert in systems engineering and requirements engineering, and has made a number of important contributions to the field.

Dr Ryan regularly consults in the fields of systems engineering, requirements engineering, communications and information systems architectures, project management, and technology management including work for the 2004 Athens Olympic Games, the Department of Defence, other government departments, defence industry, and other industry.

Dr Ryan conducts courses in systems engineering and requirements engineering as well as in the more-focused application in Defence acquisition, particularly in the development of the capability development documents (CDD) that guide acquisition in the Australian Department of Defence. He is the principal architect of the Master of System Engineering program run by the University of New South Wales in Canberra, creating the program structure and preparing the appropriate documentation for program approval. He also developed three of the four core courses in that program and is currently delivering two of the courses (systems engineering and requirements engineering).

He is a Fellow of the Institution of Engineers, Australia; a senior member of the Institute of Electrical and Electronic Engineers; a member of the International Council on Systems Engineering; and a member of the Systems Engineering Society of Australia (in which he also serves on the management committee as the academic representative and the chair of the annual conference). He is currently the Chair of the Requirements Working Group in the International Council on Systems Engineering (INCOSE).

Dr Ryan is the Editor-in-Chief of the international journal, *Journal of Battlefield Technology*, and is the author or co-author of nine books and three book chapters and over 100 technical papers and reports. He is a principal author of the *Guide for Writing Requirements*, recently published by INCOSE and is one of the authors of the revised edition of the *INCOSE Systems Engineering Handbook* (which is the basis of accreditation of systems engineers internationally).

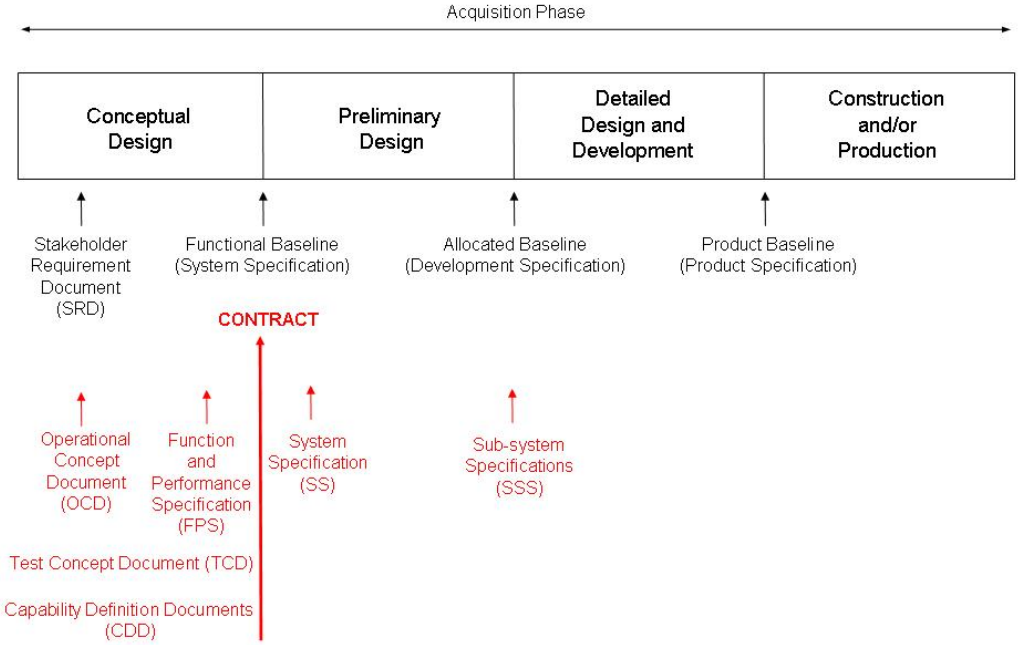
Workshop Presentation and Outcomes

What is a Capability System Model?

- Question 1: Since text-based systems acquisition (TBSA) doesn't work, what information and processes currently described in TBSA (in the OCD and FPS) would still be required to be included in some way in the MODEL which is the basis of model-based systems acquisition (MBSA)?
- Question 2: How can each information/process be modelled in MBSA, and how would that be different to TBSA?
- Question 3: What processes/information would be modelled in MBSA that do not exist in TBSA?

Systems Acquisition in Defence

Major Artefacts



OCD Template

1. SCOPE
1.1 Capability Identification
1.2 Document Purpose & Intended Audience
1.3 Justification for Capability
1.4 System Boundary and Acquisition Assumptions
1.5 Key Timeframes for Capability

2. DEFINITIONS AND REFERENCED DOCUMENTS
2.1 Referenced Documents
2.2 Glossary of Terms

3. SOLUTION-INDEPENDENT CAPABILITY NEEDS
3.1 Mission Overview
3.2 Operational Policies and Doctrine
3.3 Capability System End-user classes
3.4 Summary of Operational Scenarios
3.4.1 Common Scenario Attributes
3.4.2 Scenario 1 - Scenario Title
3.4.2.1 Summary of Situation
3.4.2.2 Summary of Military Response
3.4.2.3 Summary of Operational Needs
3.4.3 Scenario N - Scenario Title
3.5 Summary of Consolidated Operational Needs
3.6 Solution-class-Independent Constraints

4. EXISTING SYSTEM
4.1 Existing System Overview
4.2 Existing System Operational Capability Comparison
4.3 Existing System Internal Shortcomings
4.4 Existing System Planned or Active Upgrades
4.5 Existing System Internal User classes
4.6 Existing System Internal Functionality
4.7 Summary of Existing System Internal Scenarios

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OCD Template

5. SOLUTION-CLASS DESCRIPTION

5.1 Materiel System Description
5.2 Mission System Architecture
5.3 Materiel System Interfaces
5.4 Materiel System Internal User classes
5.5 Materiel System Functionality and Performance
5.6 Materiel System Spt Concepts and Reqts
5.7 Materiel System Constraints
5.8 Materiel System Evolution & Tech F'cast
5.9 Summary of Internal Scenarios
5.9.1 Internal Scenario 1
5.9.1.1 Summary of Situation
5.9.1.2 Summary of Process Flows Interactions
5.9.1.3 Summary of System Reqts
5.9.2 Internal Scenario 2 - Scenario Title
5.9.3 Internal Scenario N - Scenario Title

6. CONSOLIDATED FUNDAMENTAL INPUTS TO CAPABILITY (FIC) REQUIREMENTS

6.1 FIC Related Guidance
6.2 Major Systems FIC Element Requirements
6.3 Facilities and Training Areas FIC Element Requirements
6.4 Support FIC Element Requirements
6.5 Supplies FIC Element Requirements
6.6 Organisation FIC Element Requirements
6.7 Command and Management FIC Element Requirements
6.8 Personnel FIC Element Requirements
6.9 Collective Training FIC Element Requirements
6.10 FIC Impacts on Supporting Capabilities
6.11 Summary of Overall FIC Responsibilities
6.12 FIC Development Forecast

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FPS

- Specifies formal requirements for the System.
- Provides the basis for design and qualification testing of the system.
- Provides the vehicle for the capture of formal, verifiable and unambiguous requirements, 'distilled' from the OCD.
- Is intentionally written using formal language, with all requirements in the FPS traceable to needs in the OCD.

CDD Guide v2.0

FPS Template

Section 1 – Scope
1.1 – Identification
1.2 – System Overview
1.3 – Document Overview
Section 2 – Applicable Documents
Section 3 – Requirements
3.1 – Missions
3.2 – System Boundaries and Context
3.3 – Required States and Modes
3.4 – System Capability Requirements
3.5 – Availability
3.6 – Reliability
3.7 – Maintainability
3.8 – Deployability
3.9 – Transportability
3.10 – Environmental Conditions
3.11 – Electromagnetic Radiation
3.12 – Architecture, Growth and Expansion
3.13 – Safety
3.14 – Environmental Impact Requirements
3.15 – Useability and Human Factors
3.16 – Security and Privacy
3.17 – Adaptation Requirements
3.18 – Design and Implementation Constraints
3.19 – System Interface Requirements
Section 4 – Precedence and Criticality of Requirements
Section 5 – Verification
Section 6 – Requirements Traceability
Section 7 – Notes

Workshop Outcomes

➓ What is a (capability) model?

- An algorithm is a model
- Level of abstraction
- Conceptual model to executable model
- **Non functional requirements / constraints**
- **Expression of knowledge**
- **Behaviour of a system** (including over time)
- **Describes the structure of the environment and interfaces**
- **Visible FIC elements including the support system**
- **Performance and boundaries of execution**
- **Describes the problem**
- **Captures the requirements**
- **Fit-for-purpose representation of the capability**
- ***Structured and traceable information***

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Workshop Outcomes

⑩ What is the purpose of the (capability) model?

- Develop shared understanding
- Enables / Documents decision making
- Knowledge transfer
- To go to contract / tender
- Communicate the capability of a system to a sufficient level of fidelity (reduce risk)
- Validation baseline
- Integration of knowledge from lower level models
- To describe the relationships with the capability of your other systems

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